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PATENT SPECIFICATION

1,002,931

DRAWINGS ATTACHED

1,002,931

Date of Application and filing Complete Specification: April 20, 1964.
No. 16209/64.
Application made in United States of America (No. 274,583) on April 20, 1963.
Complete Specification Published: Sept. 2, 1965.

Index at Acceptance:—B5 K3.
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COMPLETE SPECIFICATION

Thermo-Chemical Joining of Nylon Fabrics

ERRATUM

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Page 1, Heading, Date of application made in U.S.A. *for* "April 20, 1963" *read* "April, 22, 1963"

THE PATENT OFFICE.
10th March 1966

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employing a particular class of chemical bonding agents.

In converting fabrics made from nylon fibers and filaments into garments and clothing, it is often necessary to join edges of two or more pieces of such articles. Usually, the edges are sewn together in such a manner to show a line of stitches. Sewing is not satisfactory, since nylon fabrics sewn by threads often have a tendency to pucker along the line of stitches due to uneven shrinkages, which from an aesthetic standpoint is undesirable. Methods have been worked out for piecing together nylon fabrics with threads such that the puckering effect is minimized or prevented. Unfortunately, these methods are extremely expensive. Also, various methods for stitchless joining of edges of nylon fabric by the use of adhesive and high frequency energy have been investigated without too much success.

It is an object of this invention to provide an improved method of stitchless joining of nylon fabrics by thermo-chemical union thereof.

Another object is to provide pieced together nylon fabrics wherein the pieces are held together along contiguously overlapped edges without stitches but by thermo-chemical union thereof accomplished by employing a certain class of chemical bonding agents.

In general, the objects in accordance with the

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along the edges. A length of the edges of the nylon fabrics selected as the place of seaming is coated or impregnated with a small amount of chloral hydrate bonding agent. The application of these agents can be accomplished in a variety of ways. They can be sprayed, brushed, wicked or padded onto the fabrics. In addition, the edges of the fabrics can be dipped separately or together in the chloral hydrate solution. In a preferred manner, a travelling nylon thread containing the bonding agent is sandwiched between overlapped edges of two moving nylon fabrics. Thereafter the resulting composite structure is heated while being nipped to produce a stitchless joining of the fabrics.

The chloral hydrate functions as a solvent or plasticizer of the nylon in the fabric thereby making the surfaces of the nylon fibers tacky. This tackiness results in an initial sticking together of the nylon fibers, and the subsequent heating of the fibers further softens them so that, upon their being cooled, their surfaces are fused together. The function of the chloral hydrate is to assist the heat in softening the fibers and in rendering them tacky. The resultant joint between nylon fibers is a glue-less, fusion-type joint and the use of the chloral hydrate permits a fusion type-joint to result although the fibers are heated to

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Thermo-Chemical Joining of Nylon Fabrics

We, MONSANTO COMPANY, of 800 North Lindbergh Boulevard, St. Louis, Missouri, United States of America, a corporation organized and existing under the Laws of the State of Delaware, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to thermo-chemical joining of nylon fabrics. More particularly, the invention relates to a method of thermo-chemical stitchless joining of edges of nylon fabrics in contiguous overlapped relationship employing a particular class of chemical bonding agents.

In converting fabrics made from nylon fibers and filaments into garments and clothing, it is often necessary to join edges of two or more pieces of such articles. Usually, the edges are sewn together in such a manner to show a line of stitches. Sewing is not satisfactory, since nylon fabrics sewn by threads often have a tendency to pucker along the line of stitches due to uneven shrinkages, which from an aesthetic standpoint is undesirable. Methods have been worked out for piecing together nylon fabrics with threads such that the puckering effect is minimized or prevented. Unfortunately, these methods are extremely expensive. Also, various methods for stitchless joining of edges of nylon fabric by the use of adhesive and high frequency energy have been investigated without too much success.

It is an object of this invention to provide an improved method of stitchless joining of nylon fabrics by thermo-chemical union thereof.

Another object is to provide pieced together nylon fabrics wherein the pieces are held together along contiguously overlapped edges without stitches but by thermo-chemical union thereof accomplished by employing a certain class of chemical bonding agents.

In general, the objects in accordance with the invention are accomplished by coating contiguous nylon fabrics with a solution of chloral hydrate in the area where piecing together is desired and then heating the coated area to form a stitchless strong union of the fabrics. In one preferred embodiment, nylon thread or other type of thread carrying the chloral hydrate is suitably placed in the area of fabrics to be joined; and the resulting composite structure is heated to effect union of the fabrics.

In effecting the non-sewn seaming, textile fabrics constructed of at least 50% of nylon fibrous material are placed in contiguous overlapped relationship. Where edges of the fabrics are to be united, the edges are overlapped so that joining of the fabrics is attained solely along the edges. A length of the edges of the nylon fabrics selected as the place of seaming is coated or impregnated with a small amount of chloral hydrate bonding agent. The application of these agents can be accomplished in a variety of ways. They can be sprayed, brushed, wicked or padded onto the fabrics. In addition, the edges of the fabrics can be dipped separately or together in the chloral hydrate solution. In a preferred manner, a travelling nylon thread containing the bonding agent is sandwiched between overlapped edges of two moving nylon fabrics. Thereafter the resulting composite structure is heated while being nipped to produce a stitchless joining of the fabrics.

The chloral hydrate functions as a solvent or plasticizer of the nylon in the fabric thereby making the surfaces of the nylon fibers tacky. This tackiness results in an initial sticking together of the nylon fibers, and the subsequent heating of the fibers further softens them so that, upon their being cooled, their surfaces are fused together. The function of the chloral hydrate is to assist the heat in softening the fibers and in rendering them tacky. The resultant joint between nylon fibers is a glue-less, fusion-type joint and the use of the chloral hydrate permits a fusion type-joint to result although the fibers are heated to

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considerably below their fusion temperature.

Chloral hydrate is readily soluble in water, common alcohols, e.g. methanol or ethanol and common ethers, e.g. dimethyl ether or diethyl ether. Chloral hydrate dissolved in such solvents or other solvents can be applied to the fabrics. It has been found that a preferred procedure involves dissolving a predetermined amount of chloral hydrate in water or methanol. An aqueous or methanolic solution containing 25—90% chloral hydrate on a weight basis gives excellent results. The preferred concentration of chloral hydrate in solution is 40—85 weight per cent. The concentration of chloral hydrate, as can be perceived, will depend on many factors, such as the method of application, the proportion of the liquid picked up by the fabrics or carrier thread, the polymeric structure of the nylon. The temperature of the solution when applied to the fabrics is not important. It has been found that room temperature is quite satisfactory, although higher and lower temperatures can be employed.

In the area where seaming of the fibers occur, it is necessary that the fabrics have an amount of the chloral hydrate solution sufficient to effect a strong stitchless holding together of the fabrics.

Heating at an elevated temperature is feasible by means of radiation, convection, or conduction. Preferably, the heat is supplied to the fabrics by contact with a heated surface. In this heating step the temperature of the fabrics is raised to about 50—180° C., this being considerably below the melting points of the usual nylon yarns from which the fabrics are constructed.

While heated, the fabrics to be seamed are pressed together under suitable force to effect a better seam. This can be accomplished by exerting compaction pressure on opposite sides of the area of the fabrics to be joined. However, the fabrics need not be compressed on both sides, since a good seam can be attained by pulling the treated fabrics down on a heated surface.

Finally, the fabrics are cooled prior to any further operation that imposes substantial forces tending to separate the fabrics. The cooling can be accomplished by directly applying a coolant thereto. However, merely allowing the heated area to reach equilibrium with room temperature is quite satisfactory. After cooling, the fabrics can be subjected to normal forces required in the use of the fabric as a garment and can be cut and sewed into textile apparel. There are no stitches to unravel, the seam is smooth and unpuckered; and the dyeability of the fabric seams is comparable with that of the remainder of the fabrics so that no special dyeing processing of joined fabrics is required normally.

In the accompanying drawing:

Figure 1 is a plan view of two woven nylon fabrics having overlapped edges joined in accordance with the present invention;

Figure 2 is a plan view of a second embodiment showing two thermo-chemically seamed woven nylon fabrics in composite construction with a nylon thread extending along the length of the seam;

Figure 3 is a side view schematically showing suitable apparatus for seaming nylon fabrics by the method of the present invention; and

Figure 4 is a perspective view schematically showing suitable apparatus for continuously seaming contiguous edges of two nylon fabrics having a nylon thread sandwiched therebetween.

With reference to Figure 1, it is seen that the longitudinal edges of nylon fabrics 10 and 11 pieced together thermo-chemically are placed in overlapped, parallel relation. A seam is formed in the superimposed edge portion by applying chloral hydrate solution in a suitable manner such as suggested above. Heat and pressure are applied thereafter. In a most uncomplex procedure, a hot flat iron of the household type can be used to press and splice the edges together.

In Figure 2 there are shown nylon fabrics 10 and 11 having been seamed along their edges thermo-chemically. In this instance chloral hydrate bonding agent is placed on a nylon thread 12 composed of multi-continuous filaments. The thread carrying the agent is positioned along the area of overlap. Again heat and pressure are applied to piece the fabric together without stitches. The thread can be placed outside of overlap but preferably is placed between the superimposed edges of the fabrics. The use of the thread for carrying the agent and which becomes part of the resulting composite structure generally imparts greater strength to the seams as compared to strength obtained under like conditions without the thread.

In Figure 3 an internally heated roller iron 13 is used to press and heat a nylon thread 12 carrying chloral hydrate solution to unite fabrics 10 and 11 along overlapped edges.

In Figure 4 an operation for uniting fabrics of indefinite lengths is shown. Fabrics 14 and 15 are unrolled and led through web feeding rolls 16 and 17. Adjacent edges of the fabric lay over each other for a desired distance. Nylon filament yarn 18 is supplied from a suitable source such as a bobbin of yarn 19. A solution of chloral hydrate 20 is provided in container 21. A wick material 22 supported on a rod 23 extends into the solution. Because of the absorbent ability of the wick material, the solution is applied to yarn 18 in a steady amount. The yarn carrying the solution is fed between the fabrics 14 and 15 in sandwiched relationship. A guide 24 can be used to insure proper positioning of the yarn in the area of edge overlap. The fabrics and yarn are fed between the nip pressure rolls 25 and 26. The

central portion 27 of the rolls are heated in a convenient manner. Insulators 28 can be employed to provide for more economical utilization of heat energy. The resulting stitchless seam is surprisingly strong and results in a pieced textile material of aesthetic appeal.

The fabrics which can be bonded together by the practice of the present invention can be made from continuous filament nylon yarn or from yarn thrown from nylon staple fibers. A blend of fibers or filaments of at least 50 per cent nylon textile material and no more than 50 per cent of other textile material can be used. The yarn for carrying the bonding agent is preferably nylon fibers or filaments; and therefore, the yarn will become part of the resulting structure. However, the yarn can be other types of fibers or filaments which will or will not become part of the seamed fabrics.

The fabrics and yarn for best results are composed entirely of nylon. Nylon is a long-chain synthetic polymeric amide which has recurring amide groups as an integral part of the main polymer chain. The polymer is capable of being formed into a filament in which the structural elements are orientable in the direction of the axis. Specific types of nylon from which the fibers and filaments can be manufactured include nylon-66 (polymeric hexamethylene adipamide), nylon-6 (polymeric E-aminocaproic acid), nylon-610 (polyhexamethylene sebacamide), nylon-4, nylon-7, nylon-11, and fiber-forming copolymers thereof.

The following examples illustrate specific embodiments of the present invention. All parts and percentages are on a weight basis unless otherwise indicated.

Example I

A ladies sheer hose was knitted from nylon-66 yarn. A conventional circular knitter for hose was used. The toe was opened and would have required a very expensive sewing operation to close the opening and thereby to render the hose wearable. A short piece of nylon-66 yarn (68 filaments and 420 total denier) was wetted with a methanolic solution containing 65 per cent chloral hydrate. The yarn was placed between the portion of the area of hose around the hole overlapped as if it were to be sewed with stitches. The yarn and overlapped area were heated to close the opening of the toe portion of the hose. The yarn and overlapped areas were heated at 120°C. under a pressure of 100 p.s.i. over a period of time of one second. The heated area was cooled to room temperature without disturbance. The resulting stocking had a stitchless seam on the toe portion thereof and was suitable for long wearing. The stocking was dyed and finished in the usual manner. A considerable cost saving was realized in closing the toe opening. Also, the hose did not require special dyeing procedures. In use the leg portion of the stocking wore out before any noticeable weakening of the thermo-chemical seam occurred.

Example II

A machine-made lace of open texture was constructed from nylon-66 multi-continuous filament yarn in a known manner. Opposite edges of this fabric were overlapped slightly to form a tube. A nylon-66 yarn (1230/68) of the same length as the edges was dipped into a methanolic solution containing 65 per cent chloral hydrate. This yarn was placed between the overlapped edges. The yarn and overlapped area were heated at 120°C. under a pressure of 100 p.s.i. over a period of time of one second. The heated area was cooled to room temperature without disturbance. The resulting tubular lace could resist more pulling force at the seam than the lace could itself without breaking.

Example III

Two swatches of taffeta made of nylon-66 multi-continuous filament yarn were seamed together by the practice of the present invention. The adjacent edges of the fabric were overlapped ¼-inch. Sixty-five per cent methanolic solution of chloral hydrate at room temperature was generously wicked on the area of overlap. A flat iron at 135°C. was run over the treated area until the wetted area was dried. Tear tests indicated that the thermo-chemically induced seam had excellent ability to resist rupture by tearing.

Example IV

The procedure of the three preceding examples was repeated several times employing chloral hydrate dissolved in water. In each instance the ability of the stitchless seam to resist rupture by tearing was excellent.

Similarly good seams can be produced from fabrics made of nylon-6 and other types of nylon and from fabrics made with blends of other fibers where the nylon fiber content is at least 50 weight per cent.

Thus, it is noted that the above disclosure affords several advantages. A useful method for piecing together nylon fabrics without stitching is provided. The procedure is simple and inexpensive. Circular knit ladies hose can be produced at substantially reduced cost by seaming together the toe portion thereof by the use of the thermo-chemical procedure herein described. Additionally, nylon lace can be joined in a most satisfactory manner. The resulting seam is notably resistant to tear. The dyeability of fabric seamed together by the present method is not adversely affected.

WHAT WE CLAIM IS:—

1. In a process of stitchless piecing together of textile fabrics constructed of at least 50 per cent nylon fibrous material, wherein the fabrics are coated with a chemical bonding agent and then heated to effect thermo-chemical union thereof, the improvement comprising coating overlapping edge portions of said fabrics with a solution of chloral hydrate prior to heating.

2. A process according to claim 1, comprising overlapping the edges of said fabrics, coating

the area of overlap with said solution and then heating said area.

3. A process according to claim 1 or 2, wherein the chloral hydrate is dissolved in water.

4. A process according to claim 1 or 2, wherein the chloral hydrate is dissolved in methanol.

5. A process according to any of claims 1, 2, 3 or 4, comprising overlapping the edges of said fabrics, applying said solution to a textile thread, placing the thread between said overlapping edges and then heating the area of overlap.

6. A process according to claim 5, wherein said thread is composed of nylon.

7. A process according to claim 6, wherein the thread is composed of nylon-66 or nylon-6.

8. A process according to claim 1, comprising producing a circular knit ladies hose from nylon continuous filaments, said hose having an open toe portion, coating the area of the hose adjacent the open toe portion with a solution of chloral hydrate, bringing together the coated areas and then heating the coated area to form a stitchless closure of the toe portion.

9. A process according to claim 8, wherein the nylon is composed of nylon-66 or nylon -6.

10. A process according to any of the preceding claims, wherein 25—90 weight per cent chloral hydrate in water is employed.

11. A process according to any of claims 1 to 9, wherein 25—90 weight per cent chloral hydrate in methanol is employed.

13. A process of stitchless piecing together of textile fabrics constructed of at least 50 per cent nylon fibrous material substantially as hereinbefore described with reference to the Examples.

14. A process of stitchless piecing together of textile fabrics constructed of at least 50 per cent nylon fibrous material substantially as hereinbefore described with reference to the accompanying drawing.

15. Textile fabrics constructed of at least 50 per cent nylon fibrous material when pieced together by the process claimed in any of the preceding claims.

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1,002,931 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale.

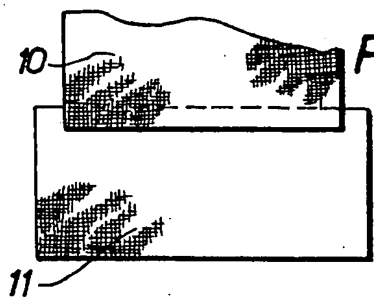

FIG.1.

FIG.2.

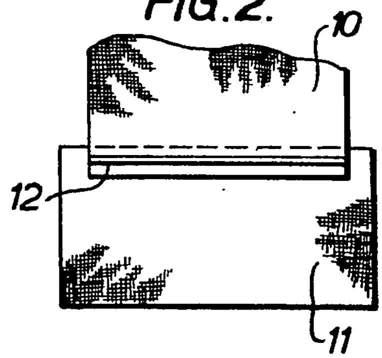

FIG.3.

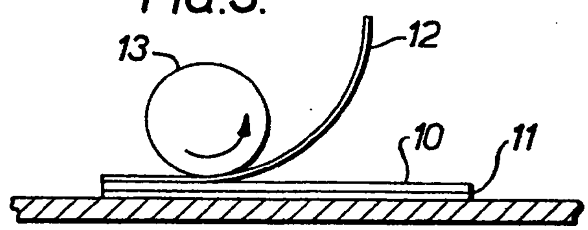

FIG.4.